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WARRIOR HOME

Market Potential Narrative

U.S. Department of Energy
Solar Decathlon 2020
Build Competition

Kaikaiknong Crescent Development
Market Potential Narrative
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Most Canadians don't realize what goes on in a First Nations community, they don't recognize the conditions we live in. You hear all those amazing projects where they go out to help third world countries; I can show you third world conditions here.

Shane Chegahno
Housing Manager, Chippewas of Nawash

Introduction

The Chippewas of Nawash Unceded First Nations community located on the Neyaashiinigmiing Reserve in Southwestern Ontario forms an integral part of the rich tapestry that is Canada's indigenous heritage. Like many Indigenous communities, however, access to adequate housing for all of its members is often a large challenge and one that is not sufficiently addressed by provincial and federal governments. With growing families and the return of community members wishing to live on their lands, the demand for good-quality, affordable housing that meets the needs of each Chippewas of Nawash community member kept rising. As a result, Warrior Home's entry for the Solar Decathlon Build Challenge aimed to address the housing crisis present in Canada's Indigenous communities through the design and construction of a sustainable home that also addresses the cultural and societal needs of the homeowner and community.

From 2018 to 2020, Warrior Home has worked closely with the Chippewas of Nawash to design and build a net-zero energy home that was made to accommodate the specific needs of the residents of the Neyaashiinigmiing Reserve. The team was able to partner with the Habitat for Humanity Grey Bruce to build a net-zero energy home in the Kaikaiknong Crescent development. After extensive consultation with community leaders, community members and the family that was chosen to receive the home, Warrior Home was able to develop an innovative and affordable design that integrates energy efficient technology, high-performance engineering systems as well as aesthetics, ergonomics, and Indigenous culture. By December 2019, students and local volunteers were able to complete the construction of the Warrior Home design and a family of 5 was able to move in.

What fueled the team to complete the design and help build the net-zero energy home were ultimately the wonderful people in the community, which include the housing authority, Chief and Band Council, the homeowners, a mother named Melissa and her four children, and many others met throughout the process. Their unique stories and needs propelled the design for the home, which itself contributed towards the promotion of sustainable development within Indigenous communities in Canada.

Warrior Home's target client for this Build Challenge was an Indigenous family consisting of a single-mother and her four children. This family was selected from a larger target market, which was low-income families. The cost of the house was approximately $220,400 CAD, with monthly payments being 25% of the family's monthly income.

Key Stats:

Location of Permanent Site:

Neyaashiinigmiing Reserve
Ontario, Canada

Client Demographic:

Single Mother of 4
- 1 Infant
- 2 Teenagers
- 1 Adult Aged

Approximate Household Income:

<$30,000 CAD

Climate Stats:

ASHRAE Climate Zone:

6A

Winter Average Low Temperature:

-35°C (-22°F)

Summer Average High Temperature:

30°C (86°F)

Precipitation:

Up to 4" of Rainfall
Up to 43" of Snow Accumulation

Community Stats:

Population (2017):

615

Existing Housing Stock:

225 Single Detached Homes
25 Semi-Detached Homes
20 Apartment & Duplexes

Market Analysis

The Warrior Home team conducted a thorough market analysis during the design process. The market analysis and research that the Warrior Home team conducted allowed our design to integrate appealing design considerations into our house, accommodate unique needs for our target client and gain a better understanding of how to design an industry-acceptable, easily reproducible home.

According to Statistic Canada's 2016 Census, approximately 1 in 5 people live in overcrowded conditions on Indigenous reserves in the province of Ontario; some 42% of homes on reserves in the reserve are in need of major repairs. Warrior Home understood the urgent need for robust housing options on reserves and chose to partner with the Chippewas of Nawash Indigenous community in 2018 for the Solar Decathlon Build Challenge.

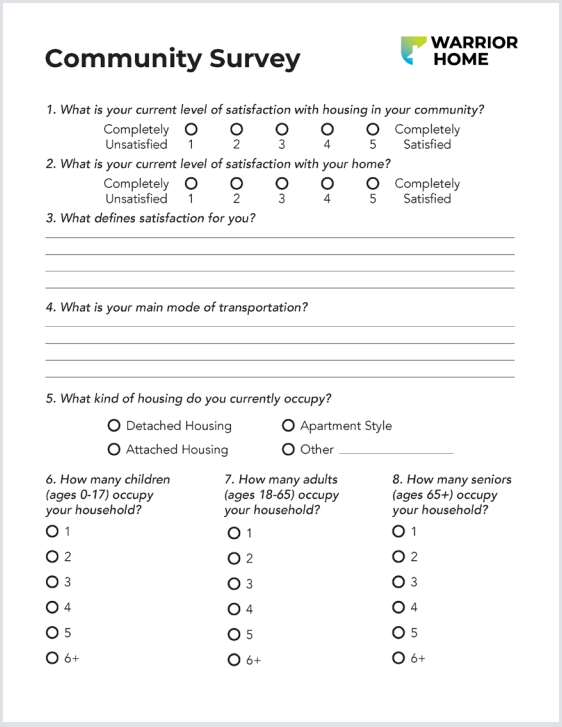
1 in 5 people experience overcrowding on reserves in Ontario

42% of homes on reserves in Ontario require major repairs

Prior to the design process, Warrior Home conducted comprehensive research into the location of the build; this information allowed our design to be the most livable and appropriate home possible for a unique location. Situated on the

Chippewas of Nawash's Neyaashiinigmiing Reserve in southwestern Ontario, Canada, between Lake Huron and Georgian Bay on Bruce Peninsula, the location of the build is scenic but also subject to extreme climate conditions, especially during the winter months. The home was designed strategically - we needed to have an energy-efficient, durable, and affordable design, while retaining reliable structural integrity for the harsh conditions that the region is exposed to. Being located in ASHRAE climate zone 6A means that the home is subject to winter temperatures below -35°C (-22°F), with heavy snow loading. During the summer, temperatures can easily reach upwards of 30°C (86°F). A high degree of airtightness to minimize unwanted thermal gains and losses was of critical importance as the goal of minimizing energy usage went far beyond the objective of achieving a net-zero designation. Due to the remote location of the home, the community does not have access to the natural gas infrastructure within the province. Therefore, most homes in the community use a diesel/propane furnace, and electricity costs are much higher in comparison to other communities. Eliminating the need for this family to rely on fuel-combustion heating alleviated the need for those energy sources, as well as the emissions associated with their use. This accomplishment was extremely rewarding to the Chippewas community, as their people take immense pride in their natural environment and its organic inhabitants.

At the onset of the design process, the Warrior Home team conducted a targeted market analysis by interviewing the Chief of the Chippewas of Nawash community, and the Chippewas of Nawash Housing Manager. Warrior Home also prepared qualitative community survey (Figure 1). The survey asked community members about their satisfaction with their current homes and what they looked for in new homes. After understanding the living conditions that their community is subject to and the lack of affordable housing that plagues many families, we decided to construct a net-zero home as part of a 19-home division that was being constructed in their community at the time. A net-zero energy home allowed the family selected to live there by the community to not have to worry about the burden of most overhead utility costs. The Chippewas of Nawash community also indicated to the Warrior Home team their collective preference for single-storey houses over duplexes or multi-residential buildings, and we set out to fulfill this desire. The home also enables the family to stay close to their extended relatives and culture, which was cited as an important consideration for members of the community.



Community Survey

WARRIOR HOME

1. What is your current level of satisfaction with housing in your community?

Completely Unsatisfied 1 2 3 4 5 Completely Satisfied

2. What is your current level of satisfaction with your home?

Completely Unsatisfied 1 2 3 4 5 Completely Satisfied

3. What defines satisfaction for you?

4. What is your main mode of transportation?

5. What kind of housing do you currently occupy?

Detached Housing · Apartment Style · Attached Housing · Other

6. How many children (ages 0-17) occupy your household?	7. How many adults (ages 18-65) occupy your household?	8. How many seniors (ages 65+) occupy your household?
1	1	1
2	2	2
3	3	3
4	4	4
5	5	5
6+	6+	6+

Figure 1
Exerpt from Warrior Home's Community Survey

When community members are housed in energy-efficient dwellings, other issues are addressed. Issues of security, of children going to school and feeling good. It addresses self-esteem. It addresses so much more than just being in shelter.

Greg Nadjiwon
Chief, Chippewas of Nawash

Warrior Home's single-storey house was customized to meet the specific needs of a target family; however, the design was also developed to be suitable for mass-production in other residential communities. In terms of costs, Warrior Home's design took the target family's income, family size and applicable on-reserve programs into consideration to create a home that was affordable without sacrificing comfort or livability for a family of 5. Seeing as the average Canadian after-tax

household income is higher than our target family's household income at $61,400 (as of 2018), and the average household size is only 2.5, our design's affordability and size are very well-placed to accommodate a broader Canadian market. Warrior Home's project was a great way for net-zero designs to gain traction in the Indigenous communities. Harsh conditions, distance from urban centres, and a low standard of living are the way of life for thousands of Indigenous Canadians. Through Warrior Home's pioneering sustainable home developments, hopefully many other developers and communities will follow suit, bridging the gap between living conditions for Indigenous communities on reserves and in cities. In terms of industry responsiveness, our team is confident in the positive feedback loop that this design incorporates. Trades can build the home easily, the renewable energy industry benefits from its unique features, and the residents benefit from the consistently low utility bills. Seeing as the entire home was built by students and volunteers with little to no experience in the construction industry, the house's design could easily be expanded and further developed into residential homes available for purchase in the private sector at all socioeconomic levels. Because we introduced our design to a low-income family, the success achieved in that arena implies future success in families with significantly more disposable income and fewer physical constraints. Our design, albeit successful, was constructed with significantly more restrictions than a home designed for the average Canadian family would be. With a few minor variances and higher amounts of conceptual freedom, this home could certainly be used as a template for thoughtful, energy-efficient residential communities.

Livability

Considering the family's financial capabilities, our design had to minimize the overhead cost that energy payments would contribute to. Therefore, in addition to the rooftop solar panels, we included a centralized heat pump backup with a heating electric resistor element that would ensure the home had reliable heat during the cold winters experienced. We also ensured that these additions could be serviced by local contractors within the community so that assistance would always be on-hand.

> ***My daughter with special needs – this is truly her home.***

Melissa Millette
Homeowner

One of the children in the target family had potential visual and physical impairment, so accessible accommodations such as safety handrails were added in the hallways in addition to the extra lighting around the home for ease of navigation. Through the synthesis of client needs and efficient design, Warrior Home has successfully created an architecturally-pleasing and sustainable home. The interior design and layout of the home was also given considerable attention as the team collected input and feedback from the family when selecting interior finishes such as flooring, counter-tops, and paint colours. For the floorplan, Warrior Home collected feedback from the community to develop the private, semi-private, and shared spaces within the home. Passive ventilation, open communal spaces, and segregated bedrooms were utilized to maximize energy efficiency while ensuring that every family member's space was protected.

In addition to the features incorporated to suit the needs of one of the children, additional accessibility recommendations were fulfilled to ensure generational enjoyment of the home by its inhabitants and respective community for years to come. The community values the idea of family and intergenerational living arrangements are common on the reserve. Our team's design incorporated an 'aging in place' philosophy so that the family had the capability of remaining in the home safely and independently - regardless of age and physical ability. This meant including fewer doors, fewer hallways, and a thoughtful flow between living spaces to maximize area efficiency. Furniture, switches, and appliances were installed with at least 30x48in. of clearing space for potential wheelchair/scooter users. We also ensured that there would be sufficient turning radius for most manual wheelchairs, which meant giving a 60in. breadth between fixed objects. Exits are clear and unobstructed in case of emergency.

The home unique accessibility and energy efficiency features were clearly explained to the family, who is making full use of these additional features. As the Warrior Home design was able to be implemented prior to the end of the build competition, our target family was able to move into their new house in December of 2019; as such the Warrior Home team was able to receive positive feedback from members of the target family who noted that the convenience, livability and comfort of the home were excellent.

Buildability

Simple building shapes were incorporated to reduce the surface area to volume ratio, and passive heating considerations such as the orientation of the home, building shape, buffer spaces, and external shading were considered. Additionally, a low window to wall ratio on the North and East sides, and a high window to wall ratio on the South and West sides ensured maximum leveraging of the sun's natural heating capabilities during the colder seasons. These passive heating considerations are an intrinsic part of the home and its construction, meaning that the home's inhabitants are maximizing the utility of these features every second. Passive cooling elements such as stacked, operable windows and passive evaporative cooling operate hand-in-glove with ventilating elements such as the central atria and lobbies, in addition to the ventilation intakes via earth tubes.

Features such as 2'x6' studs, 24" on centre, exterior foam insulation, insulated concrete formwork foundation, and raised heel-truss roof systems were implemented as part of the building's framework in order to achieve our intended goals for that segment. Advanced framing instead of standard framing was used in order for loads to be transferred directly to through the studs, minimizing the commonly experienced p-delta effects from eccentric loading. This allowed us to increase the stud interval to 24". This advanced framing route improved the building's resilience to larger-than-normal loads and/or highly dynamic ones. An additional layer of insulation in the ceiling enhanced the home's energy retention, something highly critical in a region subject to such extreme climates. These features were not complicated to implement, as proven by the ease with which our volunteers built the home. Additionally, they set a model for what responsible, future-oriented design looks like in an affordable home. Therefore, this design can act as a framework for other homes to be built off of, as none of its elements are ultra-complex or redundant. It should be noted that although advanced framing is not yet commonplace in the residential industry, the material costs saved from farther-spaced studs outweighs the additional labour hours required to implement the system. In order to promote continuous implementation of energy efficient homes in the community, the design needed to have ease of replicability. This philosophy was proven as the home was built almost exclusively by volunteers from Habitat for Humanity Grey Bruce and the Warrior Home Design Team.

The competition drawings clearly reveal the intent of the design, and show how goals were achieved through materials, construction and layout. The opening render displays the vision of the home, and allows the audience to understand the aesthetics and layout. The floor plan layout, along with the exhibit logistics clearly show the placement of rooms and interior finishes in the space, and how the space can be used to ensure maximum comfort. Electrical, plumbing and mechanical schemes are included, to satisfy MEP needs and ensure the successful application of all systems. Enclosure and assembly details, along with window installation plans aid greatly in the construction process, and ensure that labourers are aware of the required materials in their locations. Elevations and roof plan act as additional visual guides to the renders, allowing the audience to understand window, door, and solar panel placements, which were all done strategically to maximize solar gain and natural light. This working set of drawings utilizes the needed views, correct line weights, and ample callouts to ensure the audience is aware of the home's intent, and how it will accomplish the desired goals. Additionally, a thorough set of specifications was produced by the design team, totalling in 100+ pages of specifications to guide the construction, and ensure the completed home follows the developed design.

Market Potential Innovation

The newly built homes our team has created in partnership with Habitat for Humanity has helped to mitigate the severe shortage of decent, affordable housing in the Chippewas of Nawash community. Until the Kaikaiknong Crescent development was built, there was very limited available housing on the reserve. The addition of these homes has facilitated the residents to remain in contact with their community and culture by allowing them to continue living on the Neyaashiinigmiing Reserve and allowing others, such as our target family, to move back to the reserve after living elsewhere.

The home design meets and exceeds current standards of living for North American households, through its energy-efficient designs and thoughtful architectural layout. The house is also safe to live in due to its open layout, well-lit interior, and safety railings. These features were specifically incorporated with the target client in mind, as their needs could not be met with a one-size-fits-all design. The home encourages the family to make full use of its efficiency, as the utility channels in place are integrated into every-day living. A medley of smart technologies was incorporated as well, which will help ensure that the home is a strong contender on the market for years to come. These features include Wink and SmartThings, which are interfaces that allow the user to control the home's applicable technology via mobile app. This enabled the family to have complete control of their appliances at all times. Thermostats, blinds, carbon-monoxide detectors, programmable switches, and refrigerators were installed as standard features. Smart lighting paired with timed, child-proof power switches were introduced to satisfy the needs of the younger children while also reducing phantom loads. Humidifiers were also installed out of consideration for the harsh effects that the dry, windy climate of the Owen Sound region is prone to experiencing.

> ***Our goal is to build energy efficient, affordable, safe and healthy homes for our membership and this project has proven extremely successful to date. The success of this project has sparked interest from First Nations communities across Turtle Island.***

Greg Nadjiwon
Chief, Chippewas of Nawash

A vegetation schedule was developed with the intent of creating a diversified landscaping activity surrounding the house (Figure 2). The Chippewas community strongly values their connection with the surrounding environment. To ensure that our home did not impose an overly synthetic, man-made feeling, the home is situated amongst 47 unique types of native vegetation and greenery. Only native plants were used because they are relatively low maintenance and sustainable, especially given the community's familiarity with their attributes. Many of these plants are edible, and most of them are very beneficial to the environment. This design was facilitated with the implementation of two rain barrels, collecting water that falls on the roof and storing it for future garden-watering or other cleaning purposes. Using rain barrels reduces the amount of municipal water supply needed and allows the relatively clean rainwater to be reused before returning to groundwater through the soil or stormwater system. Rain gardens allow water to naturally filter through several sediment layers before returning to the central groundwater system, thus minimizing the overall strain on other drainage systems by reducing the volume they have to handle. In addition to the garden features, hardscaping elements such as a firepit and deck were included to provide a space for community members to congregate.

Figure 2
An Innovative Backyard

Floor Plan

1. Front Entrance
2. Living Room
3. Kitchen
4. Laundry Room
5. Bathroom
6. Nursery
7. Master Bedroom
8. Bedroom
9. Back Door

Conclusion

We believe our design turned into an innovative build that is of high interest to the residential home market. The energy-efficient systems we implemented, extreme ease of construction, and both the up-front and ongoing affordability of the home as a whole, makes this a very attractive template to model entire communities off of. Homes with a 'net-zero' designation are in very high demand right now, and this trend appears to remain strong for years to come. As consumers are becoming more environmentally-conscious in all arenas, the housing market is definitely one that people are excited to see changes in. Studies have also shown that water conservation features are growing in popularity. The rain barrels that Warrior Home has set up to water the garden and for any additional use is definitely a bonus in this regard.

Overall, Warrior Home is extremely proud to enter this home into the DOE's 2021 Build Challenge. We are confident that our preliminary and ongoing market analysis enabled the end users to easily navigate the home's innovative features, leading to a lasting and enjoyable standard of living. Our team is also positive that this home can be used as a building template for green communities of the future. The features we incorporated were simple, but efficient, and the structure itself can be replicated without any specialized training or prefabrication. The home's design was guided by some of Warrior Home's core principles of sustainability, livability, and practicality; these values, coupled with the target community's needs, led to the creation of a home that we are proud to have developed for the Chippewas community of Grey Bruce.

Designed and Built for an Affordable and Sustainable Future

This home felt like winning the lottery, it felt better than the lottery, I get to be closer to my mom, closer to my grandparents.

Melissa Millette
Homeowner

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